A10 cont.

23. (Amended) A method of correcting image data according to Claim 22, wherein an amount of the reduction is predetermined, and wherein an error between the predetermined amount and an actually reduced amount is added to an amount to be reduced for another line of pixels.

REMARKS

This application has been carefully reviewed in light of the Office Action dated May 8, 2002 (Paper No. 7). Claims 1 to 23 are currently in the application, of which Claims 1 to 4, 8 to 11, 17 and 21 are the independent claims. Reconsideration and further examination are respectfully requested.

The drawings were objected to under 37 C.F.R. § 1.84(p)(5) for not including the reference numeral 120, which was mentioned in the description. The drawings were also objected to for including reference numerals not mentioned in the description. In response, Applicants propose to amend the drawings as set forth in the accompanying Request For Approval Of Drawing Changes and have amended the specification to refer to the previously unmentioned reference numerals. Approval of the proposed and drawing changes and withdrawal of the objection under 37 C.F.R. § 1.84(p)(5) of the drawings are respectfully requested.

The specification was objected to for informalities. In response, Applicants have carefully reviewed and amended the specification to attend to the informalities raised in the Office Action.

Claims 1 to 3, 8, 12, 17, 19 and 22 were objected to for informalities. In response, Applicants have carefully reviewed and amended these claims to attend to the issues raised in the Office Action. Withdrawal of the objection of these claims is respectfully requested.

Claim 18 was rejected under 35 U.S.C. § 112, second paragraph. In response, Applicants have amended Claim 18 in accordance with the suggestion made in the Office Action so that Claim 18 not depends from Claim 17. Withdrawal of the § 112, second paragraph, rejection of Claim 18 is respectfully requested.

Claims 1 to 3, 17, 18, 21 and 22 were rejected under 35 U.S.C. § 102(b) over U.S. Patent No. 5,384,587 (Takagi); Claims 4 to 6, 11, 13, 14 and 20 were rejected under § 103(a) over Takagi in view of U.S. Patent No. 5,359,355 (Nagoshi); Claim 7 was rejected under § 103(a) over Takagi in view of Nagoshi and further in view of EP 0 516 420 (Arai); Claims 8 to 10 were rejected under § 103(a) over Takagi in view of Arai; Claim 12 was rejected under § 103(a) over Takagi in view of Nagoshi and further in view of U.S. Patent No. 5,488,398 (Matsubara); Claim 15 and 16 were rejected under § 103(a) over Takagi in view of Nagoshi and further in view of U.S. Patent No. 5,070,345 (Lahut); and Claims 19 and 23 were rejected under § 103(a) over Takagi. Applicants have carefully considered the Examiner's remarks and the applied references and respectfully submit that the claims herein are patentably distinguishable over the applied references for at least the following reasons.

The present invention concerns the recording on recording material by scanning a recording head relative to the recording material to form bands of an image. In

conventional systems, stripes often appear near the boundary between the bands formed by scanning the recording head. According to one aspect of the invention, this problem is minimized by obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting an ink ejection data number for each of a plurality of unit areas, where the unit areas are provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording and exist astride the boundary between adjacent bands. Control of ink ejection within these unit areas is then performed on the basis of the obtained information or counted ink ejection data number to minimize the appearance of stripes near the boundaries of the bands.

With reference to particular claim language, independent Claims 1 to 3 concern recording on a recording material by ejecting ink with relative scanning movement between a recording head and the recording material. Information indicative of an amount of ink to be ejected to each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of the recording head on the recording material is obtained and an amount of ink to be ejected to the unit areas is controlled on the basis of the obtained information. The unit areas exist astride the boundary between adjacent ones of the bands.

Independent Claim 4 concerns an ink jet recording apparatus for effecting recording on a recording material by ejecting ink using a recording head having a plurality of recording elements. The ink jet recording apparatus includes recording scanning means for effecting recording with relative scanning movement between the recording head and the recording material in a main scan direction and sub-scanning means for imparting

relative scanning movement between the recording material and the recording head in a direction which is different from the main scan direction substantially each time after completion of a recording scan in the main scan direction. Dot count means counts an ink ejection data number for each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of the recording head on the recording material. A thinning rate is determined for each of the unit areas on the basis of an output of the dot count means. Thinning means effects a thinning process to the ink ejection data on the basis of the thinning rate determined by the determining means. The unit areas exist astride the boundary between adjacent ones of the bands.

The applied references are not seen to disclose or suggest the foregoing features of the present invention. In particular, the applied references are not seen to disclose or suggest at least the feature of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting an ink ejection data number for each of a plurality of unit areas, where the unit areas are provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording and exist astride the boundary between adjacent bands.

Takagi concerns ink jet printing using a recording head having a plurality of discharge portions. Takagi is seen to disclose a method for reducing the appearance of a stripe near the boundary between image areas formed by succeeding scans of the recording head by overlapping portions of the scans and controlling the number of ink droplets discharged for pixels which overlap pixels formed during another scan. However, Takagi is not seen to disclose obtaining information regarding the ink ejection for unit areas that

are in the neighborhood of a boundary between the image areas formed by succeeding scans and which exist astride that boundary. Rather, Takagi is seen to disclose using the density data for individual pixels for controlling the number of discharged ink droplets. Therefore, Takagi is not seen to disclose or suggest at least the feature of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting an ink ejection data number for each of a plurality of unit areas, where the unit areas are provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording and exist astride the boundary between adjacent bands.

Nagoshi is not seen to remedy the foregoing deficiencies of Takagi. Nagoshi was cited in the Office Action for its disclosure of increasing the scan speed of a recording head in order to thin the image being formed on a recording medium during a scan of the recording head. However, Nagoshi is not seen to disclose or suggest at least the feature of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting an ink ejection data number for each of a plurality of unit areas, where the unit areas are provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording and exist astride the boundary between adjacent bands.

Arai, Matsubara and Lahut, which were applied in the rejections of certain other claims in the application, are not seen to remedy the foregoing deficiencies of Takagi and Nagoshi. Specifically, Arai, Matsubara and Lahut, either alone or in combination with Takagi and Nagoshi, are not seen to disclose at least the features of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting

an ink ejection data number for each of a plurality of unit areas, where the unit areas are provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording and exist astride the boundary between adjacent bands.

Accordingly, independent Claims 1 to 4 are believed to be allowable over the applied references. Reconsideration and withdrawal of the § 102(b) rejection of Claims 1 to 3 and the § 103(a) rejection of Claim 4 are respectfully requested.

According to another aspect of the invention, information indicative of an amount of ink to be ejected to each of a plurality of unit areas is obtained or an ink ejection data number for each of a plurality of unit areas is counted and an amount of ink to be ejected to an area to be thinned is controlled or a thinning process for an area to be thinned is effected, where the sizes of the unit area and the area to thinned are different.

With reference to particular claim language, independent Claims 8 to 10 concern effecting scanning on a recording material with relative scanning movement between a recording head and the recording material. Information indicative of an amount of ink to be ejected to each of a plurality of units areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of the recording head on the recording material is obtained and an amount of ink ejected to an area to be thinned in the unit areas is controlled on the basis of the obtained information. The sizes of the unit area and the area to be thinned are different from each other.

Independent Claim 11 concerns an ink jet recording apparatus for effecting recording on a recording material by ejecting ink using a recording head having a plurality of recording elements. The ink jet recording apparatus includes recording scanning means

for effecting recording with relative scanning movement between the recording head and the recording material in a main scan direction and sub-scanning means for imparting relative scanning movement between the recording material and the recording head in a direction which is different from the main scan direction substantially each time after completion of recording scan in the main scan direction. Dot count means counts ink ejection data number for each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of the recording head on the recording material. Determining means determines a thinning rate for each of the unit areas on the basis of an output of the dot count means and thinning means effects a thinning process to the ink ejection data for an area to be thinned in the unit area on the basis of a thinning rate determined by the determining means. The sizes of the unit area and the area to be thinned are different from each other.

The applied references are not seen to disclose or suggest the foregoing features of the present invention. In particular, the applied references are not seen to disclose or suggest at least the features of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting an ink ejection data number for each of a plurality of unit areas and controlling an amount of ink to be ejected to an area to be thinned or effecting a thinning process for an area to be thinned, where the sizes of the unit area and the area to thinned are different.

As discussed above, Takagi concerns ink jet printing in which succeeding scans of a recording head are overlapped as part of a system for reducing the appearance of stripes near the borders of image areas formed by each scan. However, Takagi is not seen

to disclose or suggest at least the features of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting an ink ejection data number for each of a plurality of unit areas and controlling an amount of ink to be ejected to an area to be thinned or effecting a thinning process for an area to be thinned, where the sizes of the unit area and the area to thinned are different.

Arai is not seen to disclose or suggest anything to remedy the foregoing deficiencies of Takagi. Arai concerns ink jet printing in which a thin image is recorded multiple times in order to reduce deterioration of image quality due to blurring. However, Arai is not seen to disclose or suggest at least the features of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting an ink ejection data number for each of a plurality of unit areas and controlling an amount of ink to be ejected to an area to be thinned or effecting a thinning process for an area to be thinned, where the sizes of the unit area and the area to thinned are different.

As discussed above, Nagoshi concerns forming an image by increasing a scan speed to record a thin image multiple times. However, Nagoshi is not seen to disclose or suggest at least the features of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting an ink ejection data number for each of a plurality of unit areas and controlling an amount of ink to be ejected to an area to be thinned or effecting a thinning process for an area to be thinned, where the sizes of the unit area and the area to thinned are different.

Matsubara and Lahut, which were applied in the rejections of certain other claims, are not seen to remedy the foregoing deficiencies of Takagi, Arai and Nagoshi. In

particular, Matsubara and Lahut are not seen to disclose or suggest at least the features of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas or counting an ink ejection data number for each of a plurality of unit areas and controlling an amount of ink to be ejected to an area to be thinned or effecting a thinning process for an area to be thinned, where the sizes of the unit area and the area to thinned are different.

Accordingly, independent Claims 8 to 11 are believed to be allowable over the applied references. Reconsideration and withdrawal of the § 103(a) rejections of Claims 8 to 11 are respectfully requested.

Independent Claims 17 and 21 concern effecting recording by ejecting ink onto a recording material on the basis of data using a recording head for ejecting the ink through a plurality of nozzles. Relative movement between the recording head and a recording material is controlled and ink is ejected from the recording head in accordance with ink ejection image data to sequentially effect recording operations for adjacent areas by the ink ejected from the recording head. Data indicative of ejection of the ink for boundary areas of adjacent recording areas is counted and the ejection data for the boundary areas is reduced.

The applied references are not seen to disclose the foregoing features of the present invention. In particular, the applied references are not seen to disclose at least the features of counting data indicative of ejection of ink for boundary areas of adjacent recording areas and reducing the ejection data for the boundary areas.

As discussed above, Takagi is seen to disclose reducing the appearance of stripes near the boundaries of image areas by controlling the image density of individual pixels. However, controlling the image density of individual pixels in the image areas is not seen to disclose counting data indicative of ejection of ink for boundary areas and controlling the ejection data of the boundary areas. Therefore, Takagi is not seen to disclose at least the features of counting data indicative of ejection of ink for boundary areas of adjacent recording areas and reducing the ejection data for the boundary areas.

Nagoshi, Arai, Matsubara and Lahut, which were applied in the rejections of other claims in the application are also not seen to disclose at least the features of counting data indicative of ejection of ink for boundary areas of adjacent recording areas and reducing the ejection data for the boundary areas.

Therefore, independent Claims 17 and 21 are believed to be allowable over the applied references. Reconsideration and withdrawal of the § 102(b) rejection of Claims 17 and 21 are respectfully requested.

The other claims in the application are dependent from the independent claims discussed above and are believed to be allowable over the applied references for at least the same reasons. Because each dependent claim is deemed to define an additional aspect of the invention, however, the individual consideration of each on its own merits is respectfully requested.

In view of the foregoing amendment and remarks the entire application is believed to be in condition for allowance and such action is respectfully requested at the Examiner's earliest convenience.

Applicants' undersigned attorney may be reached in our Costa Mesa, California, office by telephone at (714) 540-8700. All correspondence should be directed to our address given below.

Respectfully submitted,

Andrew D. Mickelson

Attorney for Applicants

Registration No. 30,957

FITZPATRICK, CELLA, HARPER & SCINTO
30 Rockefeller Plaza
New York, New York 10112-2200
Facsimile: (212) 218-2200

CA_MAIN 47699 v 1

VERSION WITH MARKINGS TO SHOW CHANGES MADE TO THE SPECIFICATION

Please amend the paragraph starting at page 3, line 15, as follows.

Therefore, a method of avoiding the banding in one-path printing is disclosed, thus improving the image quality.

Please amend the paragraph starting at page 10, line 17, as follows.

Figures 16A-C [are] schematically illustrate [illustration of] a recording head according to a second embodiment of the present invention.

Please amend the paragraph starting at page 17, line 14, as follows.

The respective parameters will be described. The start dot number is the total dot count at which the use of the thinning rate 12.5% (thinning rank 1) is started. The dot interval is the dot count before the next thinning rate (25% if the current thinning rate is 12.5%), that is, the range of the dot count using the same thinning rate. MAX rank is the maximum thinning rate, that is, no thinning rate beyond that is [not] selectable. If the

thinning rate reaches the MAX rank, the thinning rate is not raised, and the MAX rank thinning rate is maintained even if the dot count reaches the number corresponding to the dot interval.

Please amend the paragraph starting at page 18, line 5, as follows.

In order to enhance the resolving power for each of the parameters, the number of bits may be increased. Alternatively, the number of bits is not changed, but a common offset value may be given commonly to the start dot number, the dot interval and the MAX rank, by which the parameters can be more accurately set.

Please amend the paragraph starting at page 24, line 21, as follows.

In Figure 3, a controller 100 constitutes a main controller and includes a CPU 101 in the form of a microcomputer, a ROM 103 storing a program, a table, fixed data or the like, and a RAM 105 providing an area for conversion of the image data and a working area. The host apparatus 110 is the supply source of the image data, and it may be a computer which produces and processes image data or the like relating to the printing, or it may be a reader portion for reading images. The image data, the command, the status signal and the like are supplied to or received from the controller 100 through an interface (I/F) 112.

Please amend the paragraph starting at page 26, line 1, as follows.

The motor driver 150 is to drive the main-scanning motor 152.[, and] [t]The sub-scan motor 162 is for feeding the print medium 8 (sub-scan)[,] and the motor driver [150] 160 is a driver for the sub-scan motor 162.

Please amend the paragraph starting at page 32, line 16, as follows.

The largest among the D1, D2, UC is discriminated (step S32), by which the position of the noting dot count area (unit area) in Figure 9 is determined (step S33[2]). In this example, D1 is the largest, and therefore, it is discriminated that dot count area is in the cyan.

Please amend the paragraph starting at page 44, line 21, as follows.

The comparison is made between the sum of the dot counts of the primary color and the secondary color divided by 2 and the dot count of UC. If the latter is larger, the comparison is made between the dot count of UC divided by 2 and the [sun] sum of the dot counts of the primary color and the secondary color, and if the former is larger, the chromaticity is closest to the center, and the area is determined as the color area of the dot count area. Otherwise, the intermediate area is selected.

Please amend the paragraph starting at page 55, line 2, as follows.

The discrimination is made as to whether or not the above-described process (steps 41 to 45) has been carried out for all rows (step 46). By repeating the above-described the process for each of the rows of 8 pixels, the boundary correction process can be carried out for one line. The process for one line is carried out for each of the scans, by which the density non-uniformity occurring at the boundary between the adjacent scanning record areas, can be suppressed.

VERSION WITH MARKINGS TO SHOW CHANGES MADE TO CLAIMS

1. (Amended) An ink jet recording apparatus for effecting recording on a recording material by ejecting ink with relative scanning movement between a recording head and the recording material, said ink jet recording apparatus[,] comprising:

obtaining means for obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of said recording head on the recording material; and

control means for controlling an amount of [being] ink to be ejected to the unit areas on the basis of the output of said obtaining means,

wherein the unit areas exist astride the boundary between adjacent ones of the bands.

2. (Amended) An ink jet recording method of effecting recording on a recording material by ejecting ink with relative scanning movement between a recording head and the recording material, said ink jet recording method[,] comprising:

an obtaining step of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of [said] the

recording head on the recording material; and

a control step of controlling an amount of [being] ink to be ejected to the unit areas on the basis of the information [provided by] obtained in said obtaining step,

wherein the unit areas exist astride the boundary between adjacent ones of the bands.

3. (Amended) A data processing method of processing data to be supplied to an ink jet recording apparatus for effecting recording on a recording material by ejecting ink with relative scanning movement between a recording head and the recording material, said data processing method[,] comprising:

an obtaining step of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of [said] the recording head on the recording material; and

a control step of controlling an amount of [being] ink to be ejected to the unit areas on the basis of the information [provided by] obtained in said obtaining step,

wherein the unit areas exist astride the boundary between adjacent ones of the bands.

4. (Amended) An ink jet recording apparatus for effecting recording on a recording material by ejecting ink using a recording head having a plurality of recording elements, said ink jet recording apparatus comprising:

recording scanning means for effecting recording with relative scanning movement between the recording head and the recording material in a main scan direction;

sub-scanning means for imparting relative scanning movement between the recording material and the recording head in a direction which is different from the main scan direction substantially each time after completion of a recording scan in the main scan direction;

dot count means for counting an ink ejection data number for each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of said recording head on the recording material;

determining means for determining a thinning rate for each of the unit areas on the basis of an output of said dot count means; and

thinning means for effecting a thinning process to the ink ejection data on the basis of the thinning rate determined by said determining means,

wherein the unit areas exist astride the boundary between adjacent ones of the bands.

8. (Amended) An ink jet recording apparatus for effecting recording on a recording material with relative scanning movement between a recording head and the recording material, said ink jet recording apparatus comprising:

obtaining means for obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas provided by dividing an area in the

neighborhood of a boundary between adjacent bands of scanning recording of said recording head on the recording material; and

control means for controlling an amount of the ink ejected to an area to be thinned in the unit areas on the basis of an output of said obtaining means[;],

wherein the [inks] sizes of the unit area and the area to be thinned are different from each other.

9. (Amended) An ink jet recording method of effecting recording on a recording material by ejecting ink with relative scanning movement between a recording head and the recording material, said ink jet recording method[,] comprising:

an obtaining step of obtaining information indicative of an amount of ink to be ejected to each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of [said] the recording head on the recording material; and

a control step of controlling an amount of the ink ejected to an area to be thinned in the unit areas on the basis of an output of said obtaining step, [means;]

wherein the [inks] sizes of the unit area and the area to be thinned are different from each other.

10. (Amended) A data processing method of processing data to be supplied to an ink jet recording apparatus for effecting recording on a recording material by ejecting ink with relative scanning movement between a recording head and the recording material,

said data processing method[,] comprising:

an obtaining step of obtaining information indicative of an amount of ink to be ejected to each of a pluralityof unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of [said] the recording head on the recording material; and

a control step of controlling an amount of the ink ejected to an area to be thinned in the unit areas on the basis of an output of said obtaining step, [means;]

wherein the [inks] sizes of the unit area and the area to be thinned are different from each other.

11. (Amended) An ink jet recording apparatus for effecting recording on a recording material by ejecting ink using a recording head having a plurality of recording elements, said ink jet recording apparatus comprising:

recording scanning means for effecting recording with relative scanning movement between the recording head and the recording material in a main scan direction;

sub-scanning means for imparting relative scanning movement between the recording material and the recording head in a direction which is different from the main scan direction substantially each time after completion of recording scan in the main scan direction;

dot count means for counting an ink ejection data number for each of a plurality of unit areas provided by dividing an area in the neighborhood of a boundary between adjacent bands of scanning recording of said recording head on the recording

material;

determining means for determining a thinning rate for each of the unit areas on the basis of an output of said dot count means; and

thinning means for effecting a thinning process to the ink ejection data for an area to be thinned in the unit area on the basis of a thinning rate determined by said determining means,

wherein the sizes of the unit area and the area to be thinned are different from each other.

12. (Amended) An apparatus according to Claim 11, wherein said thinning area is divided into a plurality of areas for each of which the thinning rate is determined, and said thinning means effects the thinning process on the basis of the thinning rate determined for each of the thinning areas.

17. (Amended) An ink jet recording apparatus for effecting recording by ejecting ink onto a recording material on the basis of data using a recording head for ejecting the ink through a plurality of nozzles, said ink jet recording apparatus comprising:

recording control means for imparting relative movement between said recording head and the recording material and [rejecting thing] ejecting ink from said recording head in accordance with ink ejection image data to sequentially effecting recording operations for adjacent recording areas by the ink ejected from the recording head; and

correcting means for counting data indicative of ejection of the ink for boundary areas of adjacent recording areas and reducing the ejection data for the boundary areas.

18. (Amended) An apparatus according to Claim 17, wherein said correcting means counts the data for a line of pixels corresponding to each of the nozzles of the recording head effecting the recording for the boundary areas.

19. (Amended) An [apparatus] ink jet recording method according to Claim 2, wherein an amount of the reduction is predetermined, and wherein an error between the predetermined amount and an actually reduced amount is added to an amount to be reduced for another line of pixels.

21. (Amended) A method of correcting image data for an ink jet recording apparatus for effecting recording by ejecting ink onto a recording material on the basis of data using a recording head for ejecting the ink through a plurality of nozzles, [said] the ink jet recording apparatus imparting relative movement between [said] the recording head and the recording material and [rejecting thing] ejecting ink from [said] the recording head in accordance with ink ejection image data to sequentially effecting recording operations for adjacent recording areas by the ink ejected from the recording head, [the improvement residing in] said method comprising the step of:

[a step of] correcting the ink ejection data by counting data indicative of

ejection of the ink for boundary areas of adjacent recording areas and reducing the ejection data for the boundary areas.

22. (Amended) A[n apparatus] method of correcting image data according to Claim 21, wherein said [correction] counting step counts the data for a line of pixels corresponding to each of the nozzles of the recording head effecting the recording for the boundary areas.

23. (Amended) A[n apparatus] method of correcting image data according to Claim 22, wherein an amount of the reduction is predetermined, and wherein an error between the predetermined amount and an actually reduced amount is added to an amount to be reduced for another line of pixels.

CA_MAIN 47697 v 1